DSRRN 2013 Science Meeting

"Diadromous Species Restoration Science 2013:

Migration, Habitat, Species Interactions, and Management"

Sponsored by the Diadromous Species Restoration Research Network -

An NSF Research Coordination Network

10-11 January 2013
Wells Conference Center
University of Maine, Orono, Maine

The DSRRN Team would like to thank our Core Partners, Network Members, and Session Chairs!

DSRRN Team
Karen Wilson, University of Southern Maine
Research Coordinator
Barbara S. Arter, UM Senator George J. Mitchell Center for Environmental & Watershed Research, *Science Information Coordinator*
David Hart, UM Senator George J. Mitchell Center for Environmental & Watershed Research, *Principal Investigator*
Adria Elskus, U.S. Geological Survey, School of Ecology and Biology, University of Maine, *Principal Investigator*
Amanda Richards, UM Communications Student,
DSRRN Intern

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Joan Trial, Lew Flagg, Gail Wippelhauser
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Gayle Zydlewski
University of Maine
Michael Bailey, Jed Wright
US Fish and Wildlife Service
Trevor Avery
Acadia University
Wayne Fairchild
Fisheries and Oceans Canada Gulf Fisheries Centre

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Conference Contact:

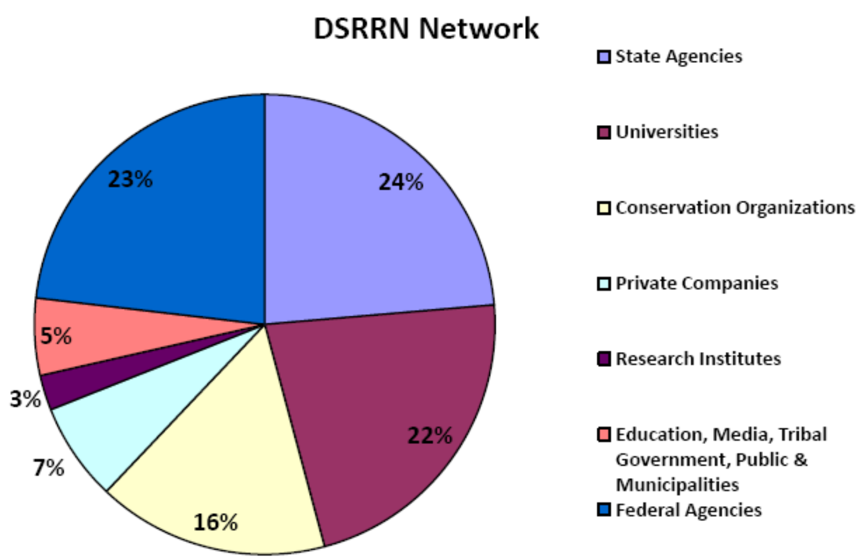
Barbara S. Arter
DSRRN Science Information Coordinator
Barbara.S.Arter@umit.maine.edu
ph: 207-546-2018 (O)
ph: 207-669-2118 (C)
www.umaine.edu/searunfish

History of the Diadromous Species Restoration Research Network (DSRRN)

DSRRN is a joint project of the Senator George J. Mitchell Center for Environmental & Watershed Research at the University of Maine and the University of Southern Maine. Funding for the project was received from the National Science Foundation. Founded in 2008, the goal of the network is to facilitate networking among researchers, managers, and stakeholders invested in diadromous fish restoration and move the science of diadromous fish restoration forward. DSRRN has fostered national, regional, and local networking and research by hosting two international sciences meetings, five workshops, and local stakeholder and science meetings:

- Science Meetings: **Restoration of Diadromous Fishes and Their Ecosystems: Confluence of Science and Restoration** (July 22-24, 2009), **Migration, Habitat, Species Interaction & Management** (January 10-11, 2013)
- Workshops: **Resilience of North Atlantic Diadromous Fish Assemblages: a Restoration Perspective** (April 1-2, 2010), **Natural Variability of North Atlantic Diadromous Fish Populations:** Establishing Reference Points for Restoration Assessment (May 26-27, 2011), **Natural Variability Part II:** Redefining the question of Variability in Alewife populations in the Gulf of Maine (June 27-28, 2012), **Paradox of the Dammed - An American shad Workshop** (June 8-9, 2012), **Adaptive Management of Diadromous Species Restoration** (January 9, 2013)
- Local Stakeholder Meeting (2008) and Penobscot River Science Exchange meetings (2009 – 2011)
- **Provided updates** via e-newsletters, updates, recent publications and its website (**http://www.umaine.edu/searunfish/**)

Where to Next? Take the survey! The DSRRN grant ends in April 2013. There will be an opportunity to discuss the future of DSRRN on Friday afternoon. Please fill out the survey if you have not done so already by visiting: https://www.surveymonkey.com/s/DSRRN13 to help us prepare for that discussion.



2013 Science Meeting

"Diadromous Species Restoration Science 2013:
Migration, Habitat, Species Interactions, and Management"

January 10-11 2013
Wells Conference Center
University of Maine, Orono, Maine

Schedule of Events

	Thursday January 10
7:30 -8:30a.m.	**Registration, Continental Breakfast & Poster setup**
8:30-9:30 am	**Opening Remarks: Karen Wilson** **Keynote Speaker: John Waldman, Queens College:** *"Is resilience theory useful to anadromous fish restoration?"*
9:30-9:40	Quick Break
9:40-9:45	**Session 1: Multi-Species Interactions in a Restoration Context** **Introduction: Rory Saunders** **Moderator: Rory Saunders**
9:45-10:05	Adrian Jordaan: Setting the baseline: historic numbers of diadromous fishes
10:05-10:25	Eric Palkovacs: Human-induced evolution and the restoration of diadromous fishes
10:25-10:45	Jaakko Erkinaro: Diversity in life histories and genetic structure in a large population complex of wild Atlantic salmon in the River Teno, northernmost Europe
10:45-11:00	Break
11:00-11:50	Margaret Guyette, John Kocik, and Steve Coghlan: Interactions among coevolved diadromous species and their implications for Atlantic salmon recovery
11:50-12:30	Discussion
12:30-1:30	**Lunch Provided**

	Thursday January 10
1:30-1:35	**Session 2: Migrations and Movements of Diadromous Fishes** **Introduction: Gayle Zydlewski** **Moderator: John Kocik**
1:35-2:05	Dan Hasselman: Linking molecular ecology and migration patterns to inform restoration baselines for Alosine fishes
2:05-2:35	Steve Lindley: Current and historic migrations of green sturgeon
2:35-2:55	Art Spiess and Gayle Zydlewski: Historic and contemporary presence of sturgeon in the Gulf of Maine: what can we learn?
2:55-3:10	Break
3:10-3:30	Claire Enterline & Brad Chase: Recent range changes by rainbow smelt (*Osmerus mordax*) and current annual migrations
3:30-3:50	Roger Rulifson: Historic and contemporary migrations of striped bass in the northwest Atlantic
3:50-4:10	Ted Ames : Were the historic movements of groundfish and migrations of river and Atlantic herring linked?
4:10-4:50	Discussion
4:50-5:00	Break
5:00-6:00	**Poster Session with Refreshments**

	Friday January 11
7:30 -8:30a.m.	**Continental Breakfast**
8:30-9:30 am	**Opening Remarks** **Keynote Speaker : Trevor Avery, Acadia University:** *“Natural variability in historical river herring catches along the east coast of North America: Local, regional, and global impacts”*
9:30-9:40	Quick Break
9:40-9:45	**Freshwater Habitat and Restoration for Diadromous Species** **Introduction: Matt Collins** **Moderator: Jed Wright**
9:45-10:00	Karen Wilson: Habitat requirements of diadromous fishes: condition, heterogeneity and connectivity
10:00-10:15	Keith Nislow: Towards a framework for linking freshwater habitats and population dynamics in northeastern anadromous fishes
10:15-10:20	Questions
10:20-10:50	Joe Wheaton and Noah Snyder: What do fish care about hydrogeomorphology? A survey of the latest techniques at a full range of spatial scales
10:50-10:55	Questions
10:55-11:10	Break
11:10-11:30	Tim Beechie: Process-based Restoration and implications for habitat conservation
11:30-11:35	Questions
11:35-12:30	Discussion and Wrap Up
12:30-1:30	**Lunch Provided and Poster Take Down**
1:30-2:30	**Keynote Speaker: Rory Saunders, NOAA National Marine Fisheries Service:** *"Evaluating the ecological effects of the Penobscot River Restoration Project"*
2:30-3:00	Discussion: Future Plans for Diadromous Research and Networking
3:00-3:30	Wrap up
3:30	Adjourn

THURSDAY MORNING

January 10, 2013

8:30a.m. Keynote Speaker: John Waldman

Queens College

"Is resilience theory useful to anadromous fish restoration?"

Abstract: Resilience theory, or the science of regime shifts, has not been a notable thread in anadromous fish restoration to date. Should it play a role? Or should the need for ecological resilience be viewed differently? We suggest that one promising avenue is the promotion of riverine habitat diversity to promote life history diversity as a means to increase population resilience of anadromous fishes.

John Waldman, Queens College, 65-30 Kissena Boulevard, Flushing, NY 11367, john.waldman@qc.cuny.edu, 718-997-3603

John Waldman is Professor of Biology at Queens College, NY. Previously, he was Senior Scientist with the Hudson River Foundation for Science and Environmental Research. He is completing a book on the historical ecology of North Atlantic diadromous fishes titled *Running Silver to Ghost Fishes*.

9:40 a.m. Session 1: Multi-Species Interactions in a Restoration Context

Introduction: Rory Saunders

Moderator: Rory Saunders

Conveners:

Karen Wilson, University of Southern Maine
Rory Saunders, NOAA's National Marine Fisheries Service
Margaret Q. Guyette, University of Maine

Session Description:

Multi-Species Interactions in a Restoration Context

Historically the east coast of North America supported up to 12 species of diadromous fishes with life histories overlapping in both time and space. In this session we explore interactions within and between diadromous species in the context of restoration to ask the following questions: what is the role of species interactions (and variability in species interactions) in maintaining populations in a restoration context? How do these interactions contribute to the success of efforts to increase species productivity and ensure population resilience over time? How do we put these ideas into action? In particular, we will explore the potential for interactions in the past, genetic shifts and life history variability in the first half of the session. In the second half of the session, we will discuss recent progress addressing hypotheses proposed by Saunders et al. (2006) who identified four potential mechanisms by which these species may have interacted that would have increased productivity of diadromous fishes: prey buffering, forage, marine derived nutrients, and habitat conditioning.

Session 1: Multi-Species Interactions in a Restoration Context
Speakers & Abstracts

Adrian Jordaan: ***"Setting the baseline: the historical decline of diadromous fish and ecological connections lost"***

Recent work has highlighted significant population declines of diadromous fish species in eastern North America. These trends are not a recent phenomenon, and can be attributed to three periods of anthropogenic pressure. This presentation will cover these periods, linking them to scales of human activity from local sources to global pressures. The resulting loss of diadromous species eroded ecological connections amongst what are now considered distinct ecosystems. Promoting restoration of diadromous species will have to reconcile local to global sources of stress on populations and ensure conservation actions are targeting the correct sources of decline. While the efforts may appear daunting, the improvement of populations will have impacts far removed from natal rivers.

Eric P. Palkovacs: ***"Human-induced evolution and the restoration of diadromous fishes"***

Human activity is driving elevated rates of evolution in many diadromous fish populations. These evolutionary changes are driven by un-natural selection and altered gene flow due to factors including harvest, stocking, hatchery-selection, landscape modification, and climate change. Human-induced evolution may have important consequences for ecological processes such as population dynamics and species interactions. Therefore, restoring native diadromous fishes and the ecosystem functions they support will require an eye towards restoring evolutionary as well as ecological processes.

Jaakko Erkinaro: ***"Diversity in life histories and genetic structure in a large population complex of wild Atlantic salmon in the River Teno, northernmost Europe"***

Atlantic salmon population complex of the River Teno system shows a wide variation in life histories and genetic divergence among large number of subpopulations in tributaries of the catchment. A total of 96 different life history combinations of smolt and sea ages and previous spawning times have been identified so far, and genetic baseline material is available from more than 30 distinct populations. This vast variation poses challenges for conservation and exploitation strategies, but also offers possibilities for pinpointing certain fractions of the complex in tailoring population-specific management actions.

Margaret Guyette, John Kocik and Stephen Coghlan: "***Interactions among coevolved diadromous species and their implications for Atlantic salmon recovery"***

Within the last decade, managers charged with planning and implementing recovery efforts for Atlantic salmon have begun to consider the importance of interactions among several coevolved diadromous species. To inform these management efforts, we are investigating the roles of two sentinel diadromous fishes – alewife and sea lamprey – in freshwater foodwebs in order to predict and quantify effects on survival, growth, and reproduction of Atlantic salmon. Results from a suite of natural and manipulative experiments suggest three potential mechanisms by which Atlantic salmon benefit directly or indirectly from the presence of alewife and sea lamprey. First, marine-derived nutrients and energy, such as those provided by spawning adults, are incorporated quickly into benthic invertebrate tissue and subsidize growth and improve physical condition of juvenile Atlantic salmon. Second, physical modification of benthic habitat by spawning sea lamprey appears to create energetically-profitable foraging stations for juvenile Atlantic salmon and increase the quality of spawning habitat for adult Atlantic salmon. Third, high densities of adult alewife have the potential to buffer outmigrating Atlantic salmon smolts from predators, thus increasing survival and escapement of this vulnerable life stage. Our current research efforts build on these preliminary results in an attempt to identify and quantify mechanistic links, and will allow us to make predictions about how dam removal and recovery of alewife and sea lamprey may impact Atlantic salmon.

Session 1: Multi-Species Interactions in a Restoration Context
Speaker Bios & Contact Information (in order of appearance)**:**

Adrian Jordaan, Department of Environmental Conservation, University of Massachusetts-Amherst. Room 309 Holdsworth Hall, 160 Holdsworth Way, Amherst, MA 01003-9285, ajordaan@eco.umass.edu, 413‑545‑2758

Dr. Adrian Jordaan is an Assistant Professor of Fish Population Ecology and Conservation in the Department of Environmental Conservation, University of Massachusetts Amherst. His early research focused on the ecology of Atlantic cod, work which convinced him of the need for more concentration on ecosystem based management concepts. He has focused on using multiple survey datasets and multivariate analyses to assign key physical variables that determine ecological spatial structuring across a variety of habitats. In 2007, Dr. Jordaan began studying the historical role of river herring (collectively alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*) in Gulf of Maine ecosystems, work which showed striking population declines of the two species with significant landscape‑level, ecological and economic impacts. Future work will use ecosystem models to identify historical ecological baselines and the potential benefits of restoration efforts in the Gulf of Maine.

Eric Palkovacs, Department of Ecology & Evolutionary Biology University of California-Santa Cruz, Long Marine Laboratory, 100 Shaffer Rd. Santa Cruz, CA 95060; epalkova@ucsc.edu, 831- 502-7387

Dr. Eric Palkovacs is an Assistant Professor in the Department of Ecology and Evolutionary Biology at the University of California-Santa Cruz and received his PhD from Yale University in 2007. Before joining the faculty of UC-Santa Cruz, he was a Visiting Assistant Professor at Duke University and a postdoc at the University of Maine. Dr. Palkovac's research focuses on interactions between ecological and evolutionary processes in aquatic ecosystems, with a specific focus on anadromous fishes. Topic currently under investigation in his lab include: stock structure and bycatch in river herring, evaluating and managing hatchery stocking practices, eco-evolutionary transitions from anadromy to freshwater residency, and consequences of fisheries harvest for contemporary evolution and ecological interactions.

Jaakko Erkinaro, Research Professor, Finnish Game and Fisheries Research Institute, P.O.B. 413, FI-90014 Oulu, Finland, jaakko.erkinaro@rktl.fi, phone: +358 405435929

Dr. Jaakko Erkinaro is a research professor with the Finnish Game and Fisheries Research Institute in Oulu, Finland. He coordinates monitoring and research programs on wild Atlantic salmon rivers, but also works in salmon restoration programs on regulated rivers in the Baltic Sea area. His fields of research have covered both freshwater and marine phases of Atlantic salmon, including aspects of migration, habitat use, long-term population dynamics, life histories and genetic diversity, for which he has published more than 60 scientific articles in peer-reviewed journals. Jaakko has been involved in several international research projects and management initiatives; he currently chairs a Finnish-Norwegian advisory group for salmon management, serves as the Finnish representative in the North Atlantic Salmon working group of the International Council for the Exploration of the Sea, and serves as a Finnish delegate to the North Atlantic Salmon Conservation Organization. Jaakko also holds an adjunct professor position with the University of Oulu, Finland.

Margaret Q. Guyette, Postdoctoral Associate, Department of Wildlife Ecology, 5755 Nutting Hall, University of Maine, Orono, ME 04469; margaret.guyette@maine.edu; phone 207-581-2939

Dr. Margaret Guyette is a Postdoctoral Associate in the Department of Wildlife Ecology at the University of Maine, Orono, where she received her PhD in 2012. Dr. Guyette's doctoral research focused on the responses of Atlantic salmon and their stream communities to marine-derived nutrients. Her current research involves using Bayesian networks to predict vegetation changes in response to fire burning patterns in Okefenokee National Wildlife Refuge.

John Kocik, NOAA Fisheries Maine Field Station, NEFSC17 Godfrey Drive - Suite 1 Orono, Maine 04473; John.Kocik@noaa.gov 207-866-7341

John F. Kocik leads the Atlantic Salmon Research and Conservation Team at NOAA Fisheries Northeast Fisheries Science Center. A native of Gloversville, NY, Kocik earned a B. Sc. in Biology at SUNY Plattsburgh and a M.Sc. and Ph.D. in Fisheries and Wildlife Science at Michigan State University. He has worked on salmon population dynamics for nearly 30 years in the Great Lakes and New England. His primary research interest is investigating the relationship between estuary and coastal ecosystems and salmonid population dynamics. The author of numerous peer-reviewed articles, Kocik is a member of several professional societies and is an active member in the American Fisheries Society.

Stephen M. Coghlan, Jr. Department of Wildlife Ecology, 5755 Nutting Hall, Room 234, University of Maine, Orono, ME 04469, Stephen_Coghlan@umit.maine.edu, 207-581-2880

Steve is an Associate Professor of Freshwater Fisheries Ecology and Management in the Department of Wildlife Ecology at the University of Maine. Steve is originally from the Finger Lakes region of New York, where his love of fly fishing on local trout streams led him away from a planned career in investment banking into aquatic ecology. He received a B.S. degree in Environmental and Forest Biology from the State University of New York College of Environmental Science and Forestry in 1998. In 2004 he received a Ph.D. in Fisheries and Wildlife Management, also from SUNY-ESF, researching the ecology of juvenile Atlantic salmon in the Lake Ontario watershed. From 2004-2006 he was a post-doctoral researcher at Arkansas State University, using otolith chemistry to study stock structure and natal homing in tailwater populations of trout. He has been a UMaine faculty member since 2006, and he teaches undergraduate and graduate courses in Statistical Ecology, General Ecology, and Freshwater Fisheries Ecology. His research program focuses on the ecology and conservation of native fishes in Maine, including the effects of dam removal on stream fishes. Steve lives in Argyle Township with his wife, four dogs, two cats, thirty chickens, and fifty thousand honeybees. In his spare time, Steve loves to fly fish, tie flies, hunt, and play guitar.

THURSDAY AFTERNOON
January 10, 2013

1:30 p.m. Session 2: Migrations and Movements of Diadromous Fishes

Introduction: Gayle Zydlewski
Moderator: John Kocik

Conveners:
Michael Bailey, USFWS
Claire Enterline, Maine Department of Marine Resources
John Kocik, NOAA Fisheries
Tara Trinko Lake, NOAA Fisheries
Gayle Zydlewski, University of Maine

Session Description:
Migrations and Movements of Diadromous Fishes

This session seeks to answer the question: Can we use historic and contemporary migration and movement patterns of diadromous fish to establish baseline conditions for restoration or recovery? Migrations and movements of diadromous fishes must be defined for implementation of successful restoration and management strategies. Linking historic and contemporary migratory range and species distributions may elucidate realistic goals for restoration. Our session will bring together historical perspectives of diadromous fish presence and current day research of movement patterns to understand possible baseline conditions for restoring and maintaining functionality of diadromous species populations. The outcome of this meeting will be not only a picture of diadromous fish migration and range but a template to link historic observations and modern techniques.

Session 2: Migrations and Movements of Diadromous Fishes
Speakers & Abstracts

Daniel Hasselman: *“ **Linking molecular ecology and migration patterns to inform restoration baselines for Alosine fishes”***

Alosine fishes along the Atlantic coast of North America have experienced rangewide population declines and are of increasing conservation concern. Population extirpations stemming from anthropogenic activities, and the potential for range shifts as a consequence of climate change, present challenges for establishing restoration baselines. Using American shad, I demonstrate how historic information about species' distributions and patterns of migration when combined with contemporary molecular data provide complementary approaches for setting recovery expectations. The rangewide spatial distribution of American shad genetic variation is consistent with a stepping stone model of population structure; spatial patterns within the Bay of Fundy support an hypothesized counterclockwise migration route. Weaker differentiation among U.S. populations relative to their Canadian counterparts suggests spatially varying philopatry and differential patterns of gene flow across the species' range. Latitudinal declines of genetic diversity are consistent with stepwise post-glacial colonization, but raise concerns about the diversity of potential source populations for future range shifts, and the consequences for long-term population persistence. The rapid dispersal and increased abundance of American shad following their introduction to the Pacific coast of North America suggests that the species can readily colonize newly available habitat through natural processes. Moreover, weaker spatial patterns of population structure for alewife and blueback herring suggests that this process may occur quickly through natural dispersal, and does not require human assistance.

Steve Lindley**: *"Current and historic migrations of green sturgeon*"**

When green sturgeon were considered for listing under the ESA in 2002, very little was known about their stock structure and use of freshwater, estuarine and marine habitats. This made evaluation of their status and vulnerability to potential threats difficult to assess. We organized a coast-wide collaboration to acoustically tag and monitor green sturgeon as they move among spawning rivers, natal and non-natal estuaries, and the coastal ocean from central California to southeast Alaska. The study yielded detailed insights into stock structure, timing and patterns of habitat use, and spawning and long-distance migratory behavior. Further work used the tagging data set and habitat information to create models that predict the distribution of green sturgeon at fine and broad scales, which should be useful for refining critical habitat designations and better understanding how green sturgeon interact with human activities such as bottom trawling, wave energy development, shellfish aquaculture, and the operation of water projects.

Arthur Spiess, Gayle Zydlewski and David Halliwell: ***"Historic and contemporary presence of sturgeon in the Gulf of Maine: what can we learn?"***

When sturgeon were recently found in the Penobscot River and their movements were assessed using acoustic telemetry, what seemed to be startling patterns were unraveled. Telemetry data indicate that both Atlantic and shortnose sturgeon make extensive marine migrations and use multiple river systems for different portions of their life. These behavioral patterns are being used to inform current restoration and management strategies for these two listed endangered species. While archeological data from scutes indicate that sturgeon movements among drainages have occurred for at least 4000 years (perhaps indicating contemporary patterns are not so startling), the scute samples have yet to be separated to the species level. In this paper we link archaeological data throughout Maine with contemporary migratory range and species distributions to (1) inform the question of realistic restoration goals and (2) suggest useful approaches to archaeological and contemporary methods that could enhance understanding from each and inform restoration goals for both species.

Claire Enterline and Brad Chase: ***"Recent range changes by rainbow smelt (Osmerus mordax) and current annual migrations"***

Historically, the range of anadromous rainbow smelt extended from Chesapeake Bay to Labrador, but over the last century the range has contracted northwards. Descriptions of smelt fisheries from the 1800s provide early accounts of the species' range and of former high abundance. A coast-wide decline in landings in the mid-1800s, prompted discussions on causal factors, led to management measures and stocking efforts, and may have been the start of the dramatic change in distribution seen today. Trawl surveys in New York and Connecticut have found that smelt may have become extirpated from this region as recently as the 1990s. Annual movements and spawning season habitat use have been largely assumed based on discrete sampling or patterns in recreational and commercial fishing. Rainbow smelt overwinter in estuaries and bays and spawn in early spring above the head-of-tide in coastal streams and rivers. Recent tagging studies are improving our understanding of near shore movements. These studies have documented males returning to spawn multiple times within the same season. Females, however, rarely ascend to the spawning grounds more than once. Post-spawn males and females may remain within embayments and tidal rivers up to two months. Smelt may migrate in search of optimum water temperatures, moving offshore during the summer months to greater depths with cooler water. Recent trawl surveys have found small schools as far from the coast as 60 km and in depths up to 77 m.

Roger A. Rulifson, R. Wilson Laney, and Ian Park: ***"Historic and contemporary migrations of striped bass in the northwest Atlantic"***

Historically, striped bass along the US east coast overwintered off the Outer Banks of North Carolina. Distribution of untagged fish during recent winters (as reflected in capture data 2007-2012), and recaptures of tagged fish demonstrate an apparent shift in distribution of wintering populations northward and offshore from traditionally observed wintering grounds. All US east coast populations have been declared fully recovered, including the large populations in the Hudson, Delaware, Chesapeake Bay, and Albemarle Sound. Although populations south of Albemarle Sound are considered non-migratory, occasional individuals from some of these populations have been recaptured off New England (Cape Fear, and Savannah river fish) and clearly migrated to the ocean. Striped bass populations from Atlantic Canada currently are depressed, and some have been extirpated for many years (e.g., Saint John's, Annapolis, St. Lawrence). Small populations exist at the northern-most extreme of the species range; several northern watersheds may provide refuge for mid-Atlantic migrants during the year. Elemental fingerprinting of coastal watersheds may provide a new method for determining the river of origin of adult migrant fish, and has the potential of telling us if, and where, adults live for extended periods.

Ted Ames: ***"Were the historic movements of groundfish and migrations of river and Atlantic herring linked?"***

Following a significant reduction in the numbers of adult Atlantic herring (*Clupea harengus*) along the eastern-most 200 km of the New England coastal shelf, Atlantic cod (*Gadus morhua*) disappeared from the area's fishing grounds. The area closely brackets the watersheds of Maine's major rivers and suggests that the rivers may be involved. Historical reports indicate that cod had previously disappeared under similar events following large reductions in the numbers of alewives (*Alosa pseudoharengus*) and bluebacks (*Alosa aestivalis*), two closely related diadromous species. Did this indicate a linkage existed between migrating herring and cod? Empirical data and fishermen's anecdotal information used to determine historical distribution and movements of cod and other groundfish species in the 1920s suggested this possibility. Cod, pollock and white hake had local groups occupying grounds near alewife rivers through the year that were joined by migrating groups arriving in late spring with adult alewives and leaving with them by fall. Cod movements correlated closely with those of adult and young-of-year alewives, implying that the historical migration patterns of cod may also have described those of alewives, bluebacks and/or Atlantic herring. Procedures and results suggesting such a linkage and the projected migration patterns of 1920s alewives are presented.

Migrations and Movements of Diadromous Fishes
Speaker Bios & Contact Information (in order of appearance)**:**

Daniel Hasselman, University of California - Santa Cruz, Long Marine Laboratory, 100 Shaffer Rd, Santa Cruz, CA 95060, dhasselm@ucsc.edu, 831- 459-1475

Daniel's research focuses on anadromous species and alosine fishes in particular. His dissertation (Dalhousie U.) examined the distribution of neutral genetic variation and spatiotemporal scale of population structure for American shad across the species' native range (Atlantic coast). His post-doctoral research (U. Washington) examined American shad in their introduced range (Pacific coast), and their ecological and evolutionary role as an invasive species. Current research (U. California) examines rangewide patterns of genetic variation for alewife and blueback herring, and involves defining discrete population segments for advising the ESA listing process.

Steven Lindley, NOAA - Southwest Fisheries Science Center, 3333 North Torrey Pines Court, La Jolla, CA 92037-1023, Steve.Lindley@noaa.gov, 831- 420-8015

Steve is the director of the Southwest Fisheries Science Center's Fisheries Ecology Division in Santa Cruz CA. After completing a PhD in biological oceanography at Duke, Steve has focused his research on the ecology of threatened anadromous fish. His research aims to create models linking human actions, habitat conditions, and population dynamics.

Arthur Spiess, Maine Historic Preservation Commission, State House Station 65, Augusta, ME 04333, arthur.spiess@maine.gov, 207- 287-2789

Art received a PhD in Anthropology from Harvard University in 1978. Since 1978 he has been employed by the Maine Historic Preservation Commission as an archaeologist. He is involved in locating, identifying and protecting significant archaeological sites, including nomination of sites to the National Register of Historic Places. Spiess's research focuses on the identification of food animal bones in Maine archaeological sites, and drawing inferences from those identifications for Native American life and the paleo-environment.

Gayle Zydlewski, Research Associate Professor of Marine Science, University of Maine, Gayle.Zydlewski@umit.maine.edu, 207-581-4365

Gayle received a PhD in Oceanography from the University of Maine in 1996. She is currently a research associate professor of marine sciences at the University of Maine where she studies migratory and marine fish and fish communities of Maine. Her current research focuses on how human-induced changes such as river restoration and tidal power development affect individual fish, fish populations and fish community structure.

Claire Enterline, Maine Department of Marine Resources, 6 Beech St, Hallowell, ME 04347, Claire.Enterline@maine.gov, 207-624-6341

Claire works for the Maine Department of Marine Resources. She is currently the municipal river herring harvest coordinator for the Sea-Run Fisheries division of the DMR and ME representative on the ASMFC River

Herring and Shad Technical Committee. Over the past six years she has coordinated a regional effort to monitor rainbow smelt populations in the U. S. Gulf of Maine, identifying threats to the species, and developing a conservation plan. Previously she worked with Massachusetts Coastal Zone Management as the grant coordinator for their Non-Point Source Pollution Remediation program.

Bradford C. Chase, Massachusetts Division of Marine Fisheries, 1213 Purchase Street, 3rd floor, New Bedford, MA 02740, brad.chase@state.ma.us, 508- 990-2860 x 118

Brad works at the Massachusetts Division of Marine Fisheries as the project leader of Diadromous Fish Biology and Management and Diadromous Fish Passage and Habitat Restoration. He is also the MA representative on American eel, River Herring and Shad Technical Committees of ASMFC and Working Group chair of the Eel Technical Committee.

Roger Rulifson, East Carolina University, Department of Biology, East Fifth Street, Greenville, NC 27858-4353, RULIFSONR@ecu.edu, 252-328-9400

Roger received his MS and PhD degrees from North Carolina State University in Raleigh. He is currently a Senior Scientist and Professor of Biology at ECU studying fisheries management and fish ecology, especially diadromous species. His lab uses traditional mark/recapture, active acoustic telemetry, and otolith chemistry to identify large-scale and small-scale movements.

Ted Ames, Penobscot East Resource Center, 13 Atlantic Ave, Stonington, ME 04681, info@penobscoteast.org, 207- 367-2708

Ted is currently a visiting research scientist at Bowdoin and member of the Marine Fisheries Advisory Committee to the U. S. Dept. of Commerce. He is a founding board member and senior advisor of Penobscot East Resource Center and has authored several peer-reviewed articles on historical fisheries ecology, fishermen's ecological knowledge, and related subjects. Ames is the recipient of a 2005 MacArthur Award, the 2007 Geddes W. Simpson Distinguished Lecturer at the University of Maine and was Bowdoin's 2010-11 visiting Coastal Studies Scholar.

FRIDAY MORNING

January 11, 2013

8:30 a.m Keynote Speaker: Trevor Avery

Acadia University

"Natural variability in historical river herring catches along the east coast of North America: Local, regional, and global impacts"

Abstract: Natural variability is omnipresent and can obscure underlying relationships within aquatic systems. Long-term herring catch data compiled from index stations from Florida to Nova Scotia are analyzed using proportional variability, a technique uncoupled from mean effects, to describe shifts in populations after accounting for natural variability. Proportional variability is related to local (watershed, physical properties), regional (predators, human population), and global (global warming) impacts to assess this analysis technique using herring as a case study.

Trevor Avery, Acadia University, 15 University Ave Wolfville, NS B4P 2R6, Canada, trevor.avery@acadiau.ca , 902-585-1873

Trevor is an aquatic ecologist/marine biologist and biostatistician. His research involves long-term monitoring of diadromous species, population dynamics and habitat use by various fishes and terrestrial animals, impacts of invasive species on fish assemblage structure, and stewardship-driven conservation. He uses ecological modeling, socio-economic biology, and video analysis in conjunction with recreational anglers, commercial fishers, and First Nations communities to fill knowledge gaps and bridge academic and local/traditional ecological knowledge.

9:40 a.m. Session 3: Freshwater Habitat and Restoration for Diadromous Species

Introduction: Matt Collins

Moderator: Jed Wright

Session Conveners:
Matt Collins, NOAA Fisheries
Joshua Royte, The Nature Conservancy
Noah Snyder, Boston College
Karen Wilson, University of Southern Maine
Jed Wright, USFWS

Charlie Baeder, Penobscot River Restoration Trust

Session Description:
Freshwater Habitat and Restoration for Diadromous Species
There are over a dozen diadromous fish species in the Northwest Atlantic that using a variety of riverine, lacustrine, estuarine, and marine habitats to complete their life cycles. For many of these species, we have limited knowledge of their freshwater habitat needs and/or their needs are not well known to, or understood by physical scientists who could pursue research to better understand the mechanics of these habitats. At the same time, diadromous species biologists working in the region could benefit by a better understanding of the physical science tools that can support their work. Contrast this situation with the West Coast where there is a longer tradition of fisheries biologists and physical scientists doing multidisciplinary work to support Pacific salmon recovery. At this session, diadromous fish biologists and physical scientists will summarize what is known and where there are gaps in our understanding of Northwest Atlantic diadromous fish freshwaters habitats and present tools to advance multidisciplinary restoration science for these fish. The information will then be framed in the context of process-based restoration, after which the speakers and the audience will participate in a facilitated panel discussion. With presentations by experts from within the region, the West Coast, and elsewhere, and with the expertise brought by our audience, the session will generate a prioritized list of research needs to support more effective restoration and management of freshwater habitats of Northwest Atlantic diadromous fish.

Session 3: Freshwater Habitat and Restoration for Diadromous Species
Speakers & Abstracts

Karen Wilson and Keith H. Nislow: "***Habitat requirements of diadromous fishes: condition, heterogeneity and connectivity"***

In this talk we review the state of knowledge for habitat use by the diverse assemblage of diadromous species currently or historically found on the east coast of North America, with the objective of identifying (1) common habitat needs or associations across species, and (2) areas in which recent advancements in hydrogeomorphology might assist in advancing research on habitat use by fishes throughout their life histories. In particular, we present this information in hopes that hydrogeomophologists can work together with fish biologists to move beyond simple fish-habitat associations towards an understanding of how the distribution and frequency of habitats are created and maintained by natural river dynamics and how these have been altered by anthropogenic stressors – essentially what habitat is missing and may be impacting our restoration efforts?

Keith H. Nislow and Karen Wilson: ***"Towards a framework for linking freshwater habitats and population dynamics in northeastern anadromous fishes"***

Effectively linking physical habitat and population conservation and restoration goals presents two essential questions of scale. From the ecological perspective, life stage-specific effects of changes in habitat conditions on growth, survival, and movement need to be projected across entire life-histories (or at least freshwater components) to assess, ultimately, impacts on population numbers. From the hydrogeomorphic perspective, landscape and watershed-scale processes need to be translated into local habitat conditions. In this talk we use several aspects of juvenile Atlantic salmon habitat (shelter availability for parr and spawning habitat) to illustrate these concepts. In the process, we demonstrate the way in which a successful framework can move between geomorphic and biological understanding to address critical questions and effectively identify key data gaps and research needs.

Joseph Wheaton and Noah Snyder: ***"What do fish care about hydrogeomorphology? A survey of the latest techniques at a full range of spatial scales"***

In this presentation, Wheaton and Snyder will review our understanding of the relationships among diadromous fish habitat, channel hydraulics and fluvial geomorphology. Wheaton will begin the presentation by focusing on studies at the scale of individual bars, and then build toward the reach scale, exploring various rapid versus high-resolution techniques to understand these relationships. Snyder will then build to larger scales, focusing on GIS-based methods for mapping habitat at scales from individual reaches to entire watersheds.

Tim Beechie: ***"Process-based Restoration and implications for habitat conservation and restoration"***

Process-based restoration aims to re-establish normative rates and magnitudes of physical, chemical, and biological processes that sustain river and floodplain ecosystems. Four process-based principles guide river restoration toward more sustainable restoration actions and increased ecosystem resilience: (1) restoration actions should address the root causes of degradation, (2) actions must be consistent with the physical and biological potential of the site, (3) actions should be at a scale commensurate with environmental problems, and (4) actions should have clearly articulated expected outcomes for ecosystem dynamics. These principles also guide watershed assessments designed to identify and prioritize necessary restoration actions. Ultimately, actions that restore watershed and ecosystem processes are most likely to sustain salmon populations in a climate altered future because they allow river channels and riverine ecosystems to evolve in response to shifting stream flow and temperature regimes.

Freshwater Habitat and Restoration for Diadromous Species
Speaker Bios & Contact Information (in order of appearance)**:**

Karen A. Wilson, Department of Environmental Science. University of Southern Maine, Gorham, Maine 04038, kwilson@usm.maine.edu, 207-780-5395

Karen earned a M. S. and Ph.D. in Limnology/Zoology from the University of Wisconsin – Madison. She is a research faculty member in the Department of Environmental Science at the University of Southern Maine where she teaches courses with an emphasis on aquatic ecology and conducts research on linkages between marine and freshwater systems as typified by river herring, diadromous fishes with a strong presence in Maine. She has also studied the long-term impacts of invasive species such as the rusty crayfish and zebra mussels on community and ecosystem properties, and worked on several aquatic restoration projects. Currently Karen is principal investigator and Science Coordinator for the NSF funded Diadromous Species Restoration Research Network (http://www.umaine.edu/searunfish/) which facilitates restoration science focused on diadromous fish and a member of an interdisciplinary research team investigating socioeconomic constraints to ecological restoration in Maine rivers.

Keith Nislow, Research Fisheries Biologist, Center for Ecosystem Change, USDA Forest Service Northern Research Station, 201 Holdsworth NRC, University of Massachusetts, Amherst, MA 01003-9285, knislow@fs.fed.us, 413-545-1765

Keith earned his PhD from Dartmouth College in 1997 following Masters and undergraduate degrees from the University of New Mexico. He leads the Fish and Wildlife Habitat Relationships Team at Amherst and is a a co-P.I. for the Northeast Climate Science Center at UMASS. He currently serves as an Associate editor for American Fisheries Society and Technical advisor to The Nature Conservancy Connecticut River Program, the USFWS Gulf of Maine Program, and the Maine Atlantic Salmon Recovery Team. His current research focuses on the relationships between environmental change (include land use and climate), aquatic habitat, and the distribution and abundance of fish and aquatic invertebrates with the intent of using these sciences to assist the restoration, conservation and management of freshwater systems in the North Atlantic region.

Joseph M. Wheaton, Department of Watershed Sciences, Utah State University, 5210 Old Main Hill, NR 360, Logan, Utah 84322-5210, joe.wheaton@usu.edu, 435-797-2459

Joe is an Assistant Professor at Utah State University and a fluvial geomorphologist with over a decade of experience in river restoration. Joe runs the Ecogeomorphology & Topographic Analysis Lab in Utah State University's Department of Watershed Science and is a leader in the monitoring and modeling of riverine habitats and watersheds. He is the co-director of the Intermountain Center for River Rehabilitation & Restoration. He worked four years in consulting engineering before completing his B.S. in Hydrology (2002, UC Davis), an M.S. in Hydrologic Sciences (2003, UC Davis), and a Ph.D. in Geography (2008, University of Southampton, UK). He worked as a lecturer in Physical Geography (University of Wales 2006-08), Research Assistant Professor in Geology (Idaho State University, 2008-09) before becoming an Assistant Professor at Utah State University (2009-present) where he teaches courses on geomorphology, fluvial hydraulics, ecohydraulics, GIS, geomorphic change detection, and river restoration.

Noah P. Snyder, Department of Earth and Environmental Sciences, Boston College, 140 Commonwealth Ave., Chestnut Hill, MA 02467, noah.snyder@bc.edu, 617-552-0839

Noah is an Associate Professor in the Earth and Environmental Sciences Department at Boston College. He is the Director of BC's Environmental Studies Program. His research focuses on understanding how rivers respond to changes, ranging from long-term variations in tectonics or climate to short-term shifts in management style or land use. Previously, he worked as a postdoctoral researcher at the U.S. Geological Survey Pacific Science Center (2001-2004) and as a geologist at the Utah Geological Survey (1994-1996). He received his Ph.D. in geology from MIT in 2001 and his B.S. in geology from Bates College in 1993.

Tim Beechie, Ecosystem Processes Research Team Leader for the Watershed Program, NOAA Northwest Fisheries Science Center, 2725 Montlake Blvd. East Seattle, WA 98112, Tim.Beechie@noaa.gov, 206-860-3200

Tim holds Bachelor's degree in geology (1983), a master's degree in fisheries (1990), and a PhD in forest hydrology (1998), all from the University of Washington in Seattle. He has researched landscape and human influences on fish populations for more than two decades, beginning with studies of fish populations in West African lakes in the mid-1980s. Current research include influences of valley and river channel morphology on salmon habitats and populations, formation and evolution of floodplain habitats, guidance for adapting river restoration plans for climate change, and developing process-based restoration strategies.

FRIDAY AFTERNOON

January 11, 2013

1:30 p.m. Keynote Speaker: Rory Saunders

National Marine Fisheries Service

"Evaluating the ecological effects of the Penobscot River Restoration Project"

Abstract: The Penobscot River Restoration Project (PRRP) is an innovative aquatic restoration project that aims to increase connectivity by removing two mainstem dams and bypassing a third dam on an upstream tributary without a subsequent loss in hydro-electric generating capacity. Given the large investments being made nationally in the field of aquatic restoration, the lack of rigorous monitoring and research to support the assertions of the beneficial effects of dam removal is surprising. Investments from a number of partners including the Nature Conservancy, the Penobscot River Restoration Trust, NOAA's Northeast Salmon Team, and over $1.3M in NOAA Restoration Center support through the American Recovery and Reinvestment Act of 2009 are now supporting rigorous ecosystem monitoring of physical, chemical, and biological parameters. Thus, the PRRP provides an important opportunity for fisheries agencies, academia, and the general public to begin to learn and understand the true ecological effects of large scale dam removals.

Rory Saunders, NOAA Fisheries Maine Field Station, 17 Godfrey Drive - Suite 1, Orono, Maine 04473, rory.saunders@noaa.gov, 207-866-7341

Rory Saunders is a fishery biologist with the National Marine Fisheries Service in Orono, Maine. He works on management and research issues related to Maine's sea-run fish communities, particularly the endangered Atlantic salmon. His recent areas of focus include developing and implementing the pre- and post-restoration monitoring strategies for the Penobscot River Restoration Project and the Sedgeunkedunk Stream restoration project. Rory is also currently focused on gaining understanding of the connections between Maine's native sea-run fish communities and how declines of one species may affect others. Rory also serves on the United States delegation to the North Atlantic Salmon Conservation Organization, an international organization that focuses on cooperation and collaboration to advance Atlantic salmon conservation across the North Atlantic.

DSSRN Poster Session
Thursday, January 10, 2013
5:00-6:00p.m.

Abstracts

(listed alphabetically by first author)

Sturgeon of the Penobscot: local residency and regional connections

Altenritter, M. E. L.[1], M. Dzaugis[2], G. B. Zydlewski[2], M. T. Kinnison[1], and J. D. Zydlewski[3]
[1]The University of Maine, School of Biology and Ecology, Orono, ME 04469, 810- 962-3231, matthew.altenritter@maine.edu
[2]The University of Maine, School of Marine Sciences, Orono, ME
[3]U. S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, Orono, ME

Two previously disregarded diadromous species were discovered in the Penobscot River only one year after the agreement to restore diadromous fish to the river was reached in 2005. Since that time, research indicates that local and regional factors are important for both shortnose and Atlantic sturgeon populations of the Penobscot River. Locally, the Penobscot River hosts and supports the feeding activities of both species throughout the spring and summer while additionally serving as an important overwintering locale for shortnose sturgeon. We have mapped prey availability and associations of prey availability with diet choices of adult shortnose sturgeon to identify diet preferences and specific feeding areas in the lower river. Regionally, acoustic telemetry has indicated exchange of both species among river systems within the Gulf of Maine occurs frequently. For example, nearly 70% of all shortnose sturgeon tagged in the Penobscot migrate to the Kennebec at some time during adulthood. From this information, it is becoming clear that populations of sturgeon in the region do not exist in isolation, but are connected via migration. Currently, research is focused on identification of critical habitat in the lower Penobscot River for both species and the applicability of metapopulation theory to elucidate shortnose sturgeon population function within the Gulf of Maine.

A brief history of Old Stream or how doing nothing can be the best strategy

Atkinson, Ernest Maine Marine Resources Division of Sea-run Fisheries, Jonesboro, ME; 207-434-5921; ernie.atkinson@maine.gov

Old Stream is a highly productive cold water tributary to the Machias River located in Washington County, Maine. The Machias River is within the Gulf of Maine Distinct Population Segment for endangered populations of Atlantic salmon (*Salmo salar*) listed under the US Endangered Species Act. Among these drainages, Old Stream is a bright point. Annual escapement to Old Stream has been high; around 30 adults annually. Juvenile densities are among the highest in the Downeast SHRU and there is strong evidence suggesting that juvenile production is positively related to natural escapement rather than through hatchery related

strategies such as fry stocking. Since 2008 there has been no enhancement from any hatchery product. The implications of this are many but two key points are; first, it reinforces that natural rearing is more likely to produce returning adults than artificial enhancements especially in years that marine survival is low among other strategies. Second, that habitat in Old Stream is functioning well thanks to projects improving access to stream reaches and helping to maintain stream functions.

Kennebec River juvenile Alosine and striped bass survey

Jason Bartlett, Gail Wippelhauser, James Beaudry and **Mark Lazzari**
Sea Run Fisheries and Habitat, Maine Department of Marine Resources, Hallowell, ME; 207-624-6550; Mark.lazzari@maine.gov

A juvenile alosine survey in the Kennebec River has been conducted at 14 sites since 1979 to evaluate the increased abundance of the alosine population following improvement of the river's water quality. A juvenile striped bass survey has been conducted at these sites and six additional experimental sites since 1994 to evaluate the abundance of the striped bass population. Each site is sampled once every other week from mid-July to early-October. All samples are taken with a 20 m beach seine (3.17mm mesh) within three hours of low slack water. An area of approximately 300m^2 is sampled.The catch per unit effort (CPUE) index is calculated by dividing the number of individuals caught in each river segment (sites are combined) by the number of seine hauls in each river segment. In 2011, 1,095 juvenile alewives, 1,057 American shad, and 184 blueback herring were caught at the standard stations while 216 alewives and 57 American shad were caught at the experimental stations. CPUEs for alewives and blueback herring were below average for most river segments and CPUEs for American shad were higher than average in most river segments. Forty-eight juvenile striped bass were captured during the 2011 sampling season. CPUEs for striped bass were below average for both the standard and experimental stations.

From Mill River to Herring River: monitoring change in diadromous fish populations in response to four barrier removal projects on a tributary to the Taunton River, Massachusetts

Michael Bednarski[1] and Beth Lambert[2]
[1]Massachusetts Division of Marine Fisheries, New Bedford, MA; 508-990-2860x114, mike.bednarski@state.ma.us[2]Massachusetts Division of Ecological Restoration, Boston, MA

The Taunton River is one of the longest undammed rivers in New England and has one of Massachusetts' largest runs of river herring. Federal, state, and local agencies and organizations are collaborating to reconnect dammed tributaries such as the Mill River to the mainstem of the Taunton River. The Mill River Restoration Partners are removing three dams and building a fish ladder and eel pass at a fourth dam. The first dam on the river was removed in 2012; others will be removed in 2013 and 2014. When complete, diadromous fish will have access to more than 30 miles tributary and mainstem habitat, plus >400 acres of lake and pond habitat. Accordingly, the project presents a unique opportunity to monitor the responses of diadromous fishes to habitat reconnection. The objectives of monitoring will be to 1) collect preliminary information, 2) assess population response and 3) quantify habitat expansion of river herring and American eel to passage restoration in the Mill River. The study will focus on assessing responses through counting stations, a mark-recapture study of eel, and a telemetry study of river herring. This poster presents the restoration project and the proposed monitoring framework. The results this project will help restoration practitioners and fisheries managers to predict the effects of restoration work on diadromous fishes.

Restoring a watershed: improving the Taunton River for both fish and people.

Cathy Bozek
The Nature Conservancy, Boston MA; 617-532-8385; cbozek@tnc.org

The Taunton River, a ~500 sq mi watershed in Southeastern Massachusetts, hosts one of the largest river herring runs in New England and was designated Wild and Scenic in 2009. However, the watershed has a long history of impacts from industry and agriculture, and is located in one of the fastest developing regions of Massachusetts. Many of the Taunton's tributaries are blocked by obsolete and deteriorating dams which obstruct fish passage and pose safety hazards for the surrounding communities. Land development and water use practices have led to water quality issues and water budget deficits which impact fish habitat as well as drinking water supplies. Protecting the Taunton for future generations demands a comprehensive approach to watershed protection, as well as coordination between freshwater, estuarine, and marine conservation strategies. With public and private partners, The Nature Conservancy is advancing innovative water management projects, removing dams, improving road crossings and stormwater management, restoring estuarine habitat, and protecting key lands. These site based strategies are linked with statewide policy efforts such as establishing streamflow standards and easing permitting of restoration projects, and regional scale research and fisheries management. Through a comprehensive, coordinated approach, the Taunton River watershed is being improved and protected for the benefit of fish populations and the surrounding human communities.

The migration and survival of Atlantic salmon kelts in estuarine and coastal regions of Canada

Jonathan Carr[1], Jenny Reid[2], and Keelan Jacobs[3]
[1] Atlantic Salmon Federation, St. Andrews, New Brunswick, Canada, E5B 3S8. jcarr@asf.ca.
[2]Miramichi Salmon Association, , South Esk, NB, Canada, E1V 4L9. [3] 5092 West Hill, Montreal, Quebec, Canada, H4V 2W5.

Sonic telemetry documented Miramichi River Atlantic salmon kelt migration patterns and survival within the estuary and Atlantic Ocean from 2008 to 2011. Survival in the estuary was high (>90%) where fish spent fewer than 20 days, mostly near the head of tide, before entering the Gulf of St. Lawrence. Eleven percent of the tagged kelts spent 44 to 68 days in the Gulf before returning as consecutive spawners. Another 3% of the tagged fish spent one winter reconditioning in the Atlantic Ocean before returning as alternate year spawners. No kelts overwintered in the estuary. Travel rates in the Gulf ranged from 10 - 69 km/day between the New Brunswick coastline and the Strait of Belle Isle (SOBI). The percent of kelts moving past the SOBI en route to Labrador Sea and possibly Greenland varied from 14 - 44% minimum. Kelt movements through the SOBI were synchronized with smolts that had been tagged in multiple rivers throughout the Gulf region. This suggests that naïve smolts may 'learn' the migration route from experienced adult salmon. Results from this study suggest that a high mortality rate occurs for reconditioning kelts in the Gulf of St. Lawrence and in the Atlantic Ocean.

Preliminary results of baseline science monitoring for the Penobscot River Restoration Project

Cheryl Daigle, Charlie Baeder and Jennifer Curtis
Penobscot River Restoration Trust, 3 Wade Street, Augusta, ME
207-232-9969; cheryl@penobscotriver.org

The National Oceanic and Atmospheric Administration (NOAA) invested $6.1 million through the American Recovery and Reinvestment Act of 2009 to help rebuild the sea-run fisheries of Maine's Penobscot River through a grant to the Penobscot River Restoration Trust, with $5 million directed toward removal of Great Works Dam, completed in November 2012. The remainder of the award and subsequent NOAA funding – a total of $1.5 million to date – has funded baseline scientific monitoring to track physical, chemical and biological changes in the river following the removal of Great Works and Veazie dams, and the decommissioning and bypass of Howland Dam. This included monitoring of: fish community structure and function, upstream and downstream fish passage at dams, assembly of diadromous species at the seaward-most dam, and import of marine derived nutrients and organic matter; vertical and horizontal channel adjustments at river cross-sections; sediment grain size distribution at cross-sections to document changes in bed material; riparian vegetation and channel configuration through photos taken at permanent stations; basic water quality; benthic macroinvertebrate community structure; and wetland and riparian plant communities. Here we summarize preliminary findings, and highlight the enormous opportunity provided by the Penobscot Project for fisheries agencies, academia, and the general public to better understand the ecological effects of large scale dam removals and the cultural and economic benefits of fisheries restoration.

Using ecosystem modeling to understand the potential impacts of restoration

Adrian Jordaan
Department of Environmental Conservation, University of Massachusetts Amherst, Amherst, MA, 01003; 413-545- 2758; ajordaan@eco.umass.edu.

Understanding long-term trends in populations is dependent on identifying the appropriate time-period and historical baseline for which to compare present abundances. Many diadromous species, including American shad (*Alosa sapidissima*), Atlantic sturgeon (*Acipenser oxyrhynchus*), Atlantic salmon (*Salmo salar*), American eel (*Anguilla rostrata*) and river herring [collectively alewive (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)] have a long history of use in river and coastal fisheries, but also have experienced declines over century time-scales. While recent trends are fairly well documented, historical baselines as well as an understanding of the ecological significance of these species towards assigning a value for their ecosystem services, has been elusive. Recently, a series of papers have highlighted the shortcomings of dependence on contemporary datasets to judge baselines, and demonstrated that long-term declines in important species have resulted in ecosystem degradation and lost fisheries production. A new research project funded by the Lenfest Ocean Program will expand this past work to encompass the Gulf of Maine, Georges Bank, Mid-Atlantic Bight and Long Island Sound. Ecosystem models will be developed that allow exchange of biomass into adjacent ecosystems to account for cross-system movements of forage and predatory fish towards providing an understanding of restoration potential. The potential impacts of restoration will be demonstrated in terms of fisheries production, but also will including ecosystem metrics that relate to dynamics.

Assessing the spawning dynamic of the American shad in the St.Lawrence R.: what is the importance of the spawning sites currently identified and how it affects our perception of the species status.

Frédéric Lecomte[1,2], Julian J. Dodson[3], Pascal Sirois[2] and Michel Legault[1]
[1]-Ministère du Développement Durable de l'Environnement, de la Faune et des Parcs, 418-627-8694 #7121; frederic.lecomte@uqac.ca
[2]-Université du Québec à Chicoutimi (Research Chair on Exploited Aquatic Species), 3-Université Laval

As for most populations along the Atlantic coast, the St.Lawrence American shad population has been impacted by the building of power dams and other impediments to migration. Because only one spawning site was known until recently (Carillon dam), concerns were raised about the viability of the species, and hence the St.Lawrence population was listed in 2003 as vulnerable. Another spawning site was identified recently (Des Prairies R.) but it is also located in the vicinity of Montreal. Thus, the persistence of both sites can be jeopardized by the likely industrial/ urban development of this area. Several past constructions have impeded the migration or simply destroyed several spawning sites. We have, however, little information concerning "pristine" population dynamics. Some observations suggest the possible existence of other spawning aggregation in several tributaries and/or directly into the St.Lawrence. We analyzed the distribution of early larvae in the St.Lawrence as seen in the past surveys. The patterns observed suggest the existence of other important spawning sites located between 100 to 200 km downstream of Montréal. This could be indicative of separate spawning populations or the occurrence of batch spawning throughout the river.

The St-Lawrence R. striped bass reintroduction program: assessing it's success and identifying the key habitats to protect and sustain this rapidly expending population.

Michel Legault[1], Pascal Sirois[2], Olivier Morissette[2], Guy Verreault[3], and **Frédéric Lecomte**[1,3]
[1]-Ministère du Développement Durable de l'Environnement, de la Faune et des Parcs, 418-627-8694 #7121; frederic.lecomte@uqac.ca; [2] Université du Québec à Chicoutimi (Research Chair on Exploited Aquatic Species), 3- Ministère des Ressources naturelles et de la Faune

Historically, the northern-most limit of the distribution of striped bass in North America was the St. Lawrence R. (Québec, Canada). Likely because of the cumulating effects of habitat destruction and overfishing, this stock was extirpated by the mid-1960's. In 2002, a reintroduction program was initiated by stocking adults and juveniles (broodstock from the

Miramichi R., New Brunswick). Between 2002 and 2011, 14 435 adults and juveniles, and more than 27 million larvae were released. In 2008, only six years after initiating the program, natural reproduction was confirmed as YOY from a natural origin were found in eel fishery surveys. Since 2009, we observed an exponential increase in YOY by-catch illustrating the success of the program. However as adult abundance remains low compared to historical records, the fishery cannot be presently opened. We present some ongoing projects focusing on the population dynamics of this newly established species. The species exploits most of the coastline of the estuary as illustrated by the distribution of the juvenile nursery areas (both shores of the middle estuary) and tagging studies showing that adults are distributed throughout more than 250 km of the estuary. The study of larval distribution has allowed us to identify a first spawning site. However, the otolith microchemistry suggests the existence of more spawning sites.

Evidence of successful spawning of American shad in the Penobscot River, Maine

Christine Lipsky and Rory Saunders
NOAA's National Marine Fisheries Service, Orono, ME;
207-866-4667; Christine.Lipsky@noaa.gov

Diadromous fish populations in Maine are at historically low levels. In the Penobscot River, Maine, annual runs of American shad (*Alosa sapidissima*) numbered in the millions prior to collapsing in the late 19th century. Today, the vast majority of historical shad spawning habitat is inaccessible causing uncertainty in terms of origin of the few extant shad that remain in the Penobscot. We used several types of sampling gear in the lower Penobscot River and Penobscot estuary as part of a community survey which documented the presence of young-of-the-year shad throughout the estuary from July through October in 2010, 2011, and 2012, the first three years of our survey. Given the close geographic distance of our lower river surveys to presumed spawning areas for American shad, we conclude that there is an extant population of Penobscot River shad. Such evidence of a locally adapted stock is vitally important as mangers weigh restoration options, such as those provided by the Penobscot River Restoration Project. Future work will include both elemental and stable isotope analyses to test hypotheses on movement and origin of juveniles.

Using a focus area approach to restore watershed-scale stream connectivity

Ben Naumann[1], Jeffrey Norment[2], David Power[2], Norm Dube[3], Merry Gallagher[4], Jed Wright[5]
[1] USDA-Natural Resources Conservation Service, Bangor ME; 207-947-6622 ext 141; bnaumann@me.usda.gov
[2] USDA-Natural Resources Conservation Service
[3] Maine Department of Marine Resources
[4] Maine Department of Inland Fisheries and Wildlife
[5] U.S. Fish and Wildlife Service

The Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife, the Natural Resources Conservation Service (NRCS), the U.S. Fish and Wildlife Service, and Keeping Maine Forests initiated a cooperative aquatic stream restoration and enhancement effort in 2011. The effort has focused on implementing on-the-ground stream restoration projects in the Penobscot River basin. The primary goals of this initiative are to: 1) restore geomorphic characteristics and function of Maine's lotic systems and, 2) enhance in-stream habitat complexity and connectivity to benefit diadromous fishes, including Atlantic salmon, and resident species, including brook trout, at a watershed scale. With thousands of problem culverts in the Penobscot River Basin, NRCS and partners are using the Pleasant River sub-watershed as a "focus area" for this restoration initiative. The poster will provide a summary of the focus area approach, progress of the cooperative effort, restoration challenges, and the creative avenues taken to get projects moving forward.

Using hydroacoustics to investigate prey buffering during Atlantic salmon smolt migration in the Penobscot Estuary, Maine, USA

Michael O'Malley, Rory Saunders, and Justin Stevens
NOAA's National Marine Fisheries Service, Orono, ME; 207-866-3758;
Michael.O'Malley@noaa.gov

Prey buffering is hypothesized to influence the success of Atlantic salmon smolts as they migrate to the ocean. The estuarine environment is a critical juncture during this migration, as smolt losses are high in a relatively narrow window of time and space. Co-occurring species in the pelagic complex in the Penobscot estuary include river herring (*Alosa pseudoharengus* and *A. aestivalis*), American shad (*A. sapidissima*), rainbow smelt (*Osmerus mordax*) and Atlantic herring *Clupea harengus*. However, abundance of diadromous species is historically low, theoretically reducing any prey buffering effect from these species and consequently impacting smolt survival negatively. We used multi-frequency split-beam techniques (38 and 120 kHz) to evaluate the potential for inter-specific prey buffer effects. This survey method provides information on fish target size, relative densities, and spatial distribution of fish in the estuary when properly validated. Our results demonstrate the potential for spatial and temporal overlap of salmon smolts and pelagic species in the estuary, the first step in testing a prey buffer effect. When coupled with recent findings from ultrasonic telemetry investigations, our hydroacoustic surveys provide preliminary insight into the role that the co-occurring suite of diadromous and marine fish play as salmon smolts transition to the marine environment.

Using natural tags to determine marine and freshwater habitat use by juvenile blueback herring (*Alosa aestivalis)*

Molly L. Payne[1], Karen A. Wilson[2],
[1]Department of Biological Sciences, University of Southern Maine, Portland, Maine;
315-749-6182; molly.payne@maine.edu
[2]Department of Environmental Science, University of Southern Maine, Gorham, Maine;

Blueback herring *(Alosa aestivalis*) are anadromous, migratory, schooling fishes believed to spend most of their life cycle at sea. Understanding where and when blueback herring *(Alosa aestivalis*) use freshwater, estuarine and nearshore marine habitat has significant implications for management and species restoration efforts. Habitat use by blueback herring in juvenile stages is poorly understood in their northern range. We hypothesize that juveniles with access to larger areas of freshwater and estuarine habitat will show evidence of greater use of these areas before migrating out to sea.~We used otolith microchemistry (specifically Sr:Ca ratios) to examine habitat use. Seven river sites in Maine were selected to cover a gradient of estuary size from approximately 4700 to <1300 hectares. The ambient water concentration of Sr in each habitat type was found to be highly correlated with salinity (R^2 = 0.9943) and therefore deemed an appropriate marker of habitat use in otoliths. We present results from fish taken from two river sites in our preliminary analysis.

Trends in catch-per-unit-area (CPUA) and abundance ranks of two at-risk diadromous species, Atlantic salmon (*Salmo salar)* and American eel (*Anguilla rostrata*), in Nova Scotia Southern Upland rivers (1980 – 2010)

Danielle Quinn[1], Trevor Avery[1], and Jamie Gibson[2]
[1]Acadia University, Wolfville, Nova Scotia, Canada, 902-690-5422; danielle.quinn@acadiau.ca
[2]Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada

The Nova Scotia Southern Upland Atlantic salmon (*Salmo salar*) population was assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November, 2010, and American eel (*Anguilla rostrata*) were recommended to be upgraded to Threatened in May, 2012. Over 5000 electrofishing surveys from 72 Nova Scotia rivers (primarily located in the Southern Uplands) reported presence and abundances of 39 fish species between 1965 and 2009. Generalized linear models used to quantify annual rates of change in catch-per-unit-area (CPUA) of Atlantic salmon and American eel at various spatial and temporal resolutions were performed and contributions of a non-native piscivore, smallmouth bass (*Micropterus dolomieu*) to changes in CPUA and species rank were evaluated. Of 13 rivers with sufficient data for modeling between 1980 and 2010, Atlantic salmon CPUA significantly declined in 3 rivers, with annual decline rates between 3.9 and 7.7%. An additional 4 rivers showed declining Atlantic salmon CPUA trends that were not significant at α=0.05. American eel CPUA declined in 6 rivers, with a maximum annual decline rate of 11%. Recent years often experienced higher rates of decline. Smallmouth bass appear to influence Atlantic salmon CPUS and abundance rank, but this trend does not hold for American eel. Information presented from these analyses may benefit recovery strategies of these at-risk diadromous fish species.

Adaptively managing accelerated growth 0+ parr in the Pleasant River, Penobscot watershed, Maine

Peter Ruksznis, Joan G. Trial, Oliver N. Cox
Maine Department of Marine Resources, Peter.Ruksznis@maine.gov 207-941-4487

The Penobscot River has been stocked with Atlantic salmon 0+ parr produced as a byproduct of the 1-year smolt program at Green Lake National Fish Hatchery for decades. However, the contribution of these parr to adult returns was never assessed. Marking parr stocked in the Pleasant River over the period 2002 to 2011 allowed us to determine their age at emigration and contribution to adult returns. Smolt trap catches from 2004 to 2010 documented that larger stocked parr emigrated the following spring and smaller parr required another 20 or 32 months growth before reaching smolt size. This information resulted in our current distribution plan: larger parr are stocked in sites lower in the river, smaller parr in sites higher in the watershed, and loads with mixed sizes in the middle reaches. Thus, parr most likely to remain in the river are put in cooler summer habitat. Returns from marked cohorts were encountered at Veazie starting in 2005. From 2005 to 2011 a total of 329 adults returned from 864,523 parr stocked for an overall return rate of approximately 4 adult returns per 10,000 parr stocked. When possible adult returns from parr socking were released in the lower Penobscot River to migrate and spawn. Based on redd surveys most spawned in the Pleasant River sub-drainage.

Monitoring changes in diadromous populations resulting from fish passage improvements on the Acushnet River, Massachusetts

John J. Sheppard[1] and Steve Block[2]
[1]Massachusetts Division of Marine Fisheries, New Bedford, MA 02740; 508990 – 2860 x109; John.sheppard@state.ma.us
[2]National Oceanic and Atmospheric Administration Restoration Center, Gloucester, MA 01930

The Acushnet River has been the focus of a cooperative effort to implement diadromous fish passage improvements to three barriers which had impeded migration of river herring and juvenile American eels (elvers). Fish passage restoration began in 2002 with the construction of a Denil fishway at the New Bedford Reservoir Dam and continued in 2007 with improvements to fish passage at the Acushnet Sawmill Dam and the Hamlin Street Dam. Both sites were fitted with innovative nature-like fishways, including a stone flow-constrictor, step-pool system at the former and a stone step-weir system at the latter. To measure the success of the fish passage restoration activities, monitoring of river herring and elver populations was conducted pre- and post-construction using census counting and abundance estimation, respectively. Monitoring results indicated an increasing trend of spawning adult river herring returning to the reservoir with the total count in 2011 representing an increase of 1140% over pre-construction conditions. Post-construction monitoring also suggests increased elver recruitment into the river as well as increased proportions of elvers accessing habitat in the upper watershed that was mostly inaccessible prior to fishway installation. Results suggest that these fishways have improved passage for both species, thereby increasing the probability of restoring healthy populations of diadromous fish to the Acushnet River system.

River herring bycatch in the small mesh bottom trawl fishery targeting Atlantic herring

Melissa Smith and Matthew Cieri
Department of Marine Resources, Boothbay Harbor, ME
207-633-9527; Melissa.Smith@maine.gov.

Activity of small mesh bottom trawl (SMBT) vessels targeting Atlantic herring (*Clupea harengus*) has recently increased. While federal observer coverage for Atlantic herring focused primarily on mid-water trawl and purse seine gear types, limited observer data has indicated that SMBT vessels may encounter river herring (both alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*) as bycatch. The goal of this pilot project was to document river herring bycatch at sea, sampling on SMBT vessels targeting Atlantic herring in Management Area (MA) 1A (GOM) and 2 (Southern New England). A total of 28 fishing trips were observed during the course of this project; 14 each in MA 1A and 2. Fishing effort was highly variable, resulting in observer coverage ranging from 4.7-5.6% in MA 1A. Coverage during one winter season in MA 2 was 8.4%. River herring bycatch accounted for <1% of total Atlantic herring landings in both MAs. In this case, a state-run at-sea observing program proved feasible and effective in answering management-specific research questions within a local fishing community. Fishermen participation increased over time within the project and has offered prospects for future collaborative research.

Spawning performance and release site fidelity of Atlantic salmon translocated within the Penobscot basin to novel headwater habitat.

Randy Spencer[1], 207- 941-4454 randy.spencer@maine.gov,
Kevin Gallant[1], and Denise Buckley[2]
[1] Bureau of Sea Run Fish and Habitat, Maine Dept. of Marine Resources, Bangor, Maine.
[2] United States Fish and Wildlife Service, Craig Brook National Fish Hatchery, East Orland, Maine

Adult salmon translocation was investigated as a method of circumventing imprinting and fish passage deficiencies and promoting spawning in productive headwater habitat. Returning adult salmon originating as stocked hatchery smolts were captured in May and June and held at a hatchery until October; then trucked 156 km upriver (bypassing seven dams) and released into superior headwater spawning habitat. Translocation occurred within 10 days of expected spawning date to minimize post-release homing to the original smolt stocking sites in the lower river. Salmon were translocated in 2009 (57 females, 47 males) 2010 (79 females, 40 males) and 2011 (109 females, 57 males). A subsample of female salmon were radio-tagged each year to monitor post release movements and redd counts were conducted to assess spawning success. During the three year study, most fish (87.5%) moved downriver immediately after release but 45.7 % remained in the targeted habitat and spawned successfully within 4.2 ± 1.9 km (mean± se) of the release location. Preliminary population assessments indicate a 10-30 fold increase in wild parr production relative to low river spawners. Typically less than 25% of study fish homed to their original smolt release sites. Excessive downstream smolt mortality at multiple dams currently precludes headwater smolt stocking. Adult translocation is an efficient interim method of promoting s*p*awning in the most productive habitat until upstream and downstream connectivity issues are resolved.

Evidence of the Penobscot River Estuary Providing River Herring Nursery Habitat

Justin Stevens[1], Dill, Richard[2], Borsky, Alexander[3] [1]NOAA's National Marine Fisheries Service; 207-866-4166; Justin.Stevens@noaa.gov
. [2]Maine Department of Marine Resources, Bangor, Maine
. [3]University of Maine, School of Marine Sciences , Orono, Maine

Alewife and blueback herring are two diadromous species of river herring designated by NOAA Fisheries as Species of Concern due to their historically low abundance. The Penobscot River currently maintains remnant populations of river herring and is undergoing a large-scale multi-dam removal restoration project aimed at restoring connectivity between freshwater and marine habitats and improving diadromous fish abundance. River herring use of estuarine habitat is poorly understood but it has been characterized as transitional habitat for migrants rather than a significant nursery area. NOAA Fisheries initiated a comprehensive fisheries survey of the Penobscot estuary to monitor and describe pre- and post- dam removal conditions using mid-water trawling, seining, fyke nets and hydroacoustics. Sampling from April through October 2011 and 2012 confirmed the presence of river herring in the estuary. Further analysis indicates that multiple year classes of river herring use the Penobscot estuary including adults and juveniles (ages 0-2) and that juvenile river herring account for a significant portion of the estuarine biomass during the year. These findings provide a baseline for characterizing the dynamics of this habitat for river herring and their role in the ecosystem. Further investigation is required to determine the ecological significance of this habitat for the Penobscot river herring population and how conditions may change as restoration progresses.

Path choice and survival of Atlantic salmon smolts in the Penobscot River, Maine

Dan Stich[1], Bailey, Michael[2]. Christopher Holbrook[3], Michael Kinnison[4], John Kocik[5] , Gayle Zydlewski[6] Joseph Zydlewski[7]
[1]Department of Wildlife Ecology, University of Maine, Orono; 518-860-4107; daniel.stich@maine.edu
[2]US Fish and Wildlife Service, Central New England Fishery Resource Office
[3]US Geological Survey, Great Lakes Science Center, Hammond Bay Biological Station
[4]School of Biology and Ecology, University of Maine, Orono
[5]National Oceanic and Atmospheric Administration North East Fisheries Science Center
[6]School of Marine Sciences, University of Maine, Orono
[7]US Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono

The effects of dams and in-river flow on Atlantic salmon smolt migration and survival were studied in the Penobscot River, Maine to develop baseline knowledge prior to the removal of two dams in the river. Wild (n=417) and hatchery-reared (n=1228) Atlantic salmon smolts were acoustically tagged and released at multiple locations in the Penobscot River from 2005 through 2011 during spring. Smolt survival was characterized in impounded and free-flowing sections of the Penobscot River using estimated in multi-state, Cormack-Jolly-Seber (CJS) mark-recapture models that included path choice through a secondary migration route (Stillwater Branch). Reach-specific movement rates and survival probabilities of Atlantic salmon smolts were higher in free-flowing reaches of the river than in reaches containing dams. Most acoustically tagged smolts (mean of 88% annually) migrated downstream through main stem of the Penobscot River each year, and not the Stillwater Branch. The probability of migration through the Stillwater Branch was positively related to flow. Atlantic salmon smolt survival varied between reaches each year, and generally was higher in free-flowing river reaches than in impounded reaches. Smolt survival generally was higher at dams being removed than at dams that will remain in the Penobscot River. However, the results of this study may be useful for prioritizing improvement of downstream smolt passage at remaining dams.

Restoring natural stream hydrology in the Machias watershed.

Jacques Tardie, Steve Koenig
Project SHARE, 207- 460-2865 jacquestardie@gmail.com

SHARE has spent the last few years restoring natural stream hydrology in Downeast Maine. Here, we document the effects of watershed-scale restoration in the West Branch Machias and Old Stream watersheds on fish community, habitat quality, and temperature. Significantly increased access to 1st and 2nd order streams may affect the ways we stock approach stocking regimes in these watersheds. Last, we discuss the viability of watershed-scale, intensive restoration efforts, and the processes required for efficient utilization of resources.

Diadromous Fish Passage Restoration on the Pawcatuck River, Rhode Island

James Turek[1],Kristen H. Ferry[2], Matt Bernier[3]
[1]NOAA Restoration Center, Narragansett, RI, 401-782-3338, James.G.Turek@noaa.gov;
[2]NOAA Restoration Center, Gloucester, MA;, [3]NOAA Restoration Center, Orono, ME

The Pawcatuck River is a 300-mi^2 Southern New England watershed which historically provided significant spawning and rearing habitats for diadromous fish.~Eight mainstem dams and 20 tributary barriers contributed to the decline of its river herring (*Alosa pseudoharengus, A. aestivalis*), American shad (*A. sapidissima*), and American eel (*Anguilla rostrata*) populations. ~A 2009 NOAA-ARRA funding award targeted restoring passage at three remaining upper river mainstem barriers: (1) removal of Lower Shannock Falls (LSF) dam, bedrock ledge modification, and installation of nature-like weirs; (2) installation of a Denil fishway (11.75-ft hydraulic drop) and eel pass at Horseshoe Falls dam; and (3) removal of the Kenyon Mill dam and installation of a nature-like fishway (5.5-ft hydraulic drop).~ Completion of these projects opens 21 river miles to migratory fish, plus access to 1,160+ lacustrine acres for alewife spawning and nursery habitat, including Wordens Pond, Rhode Island's largest freshwater lake. ~Predicted river flows for the alosines upriver migration period and the technical and social challenges affecting fishway design at each site are summarized.~ The nature-like fishway design; predicted hydraulics affecting turbulence; and diagnostic field assessment of the LSF site are discussed. To expedite herring restoration in the system, adult herring returning to a nearby system were released into Wordens Pond in 2012. In future years, fish passage surveys and performance monitoring will be completed by RIDEM with assistance from NOAA and other project partners.

Timing of alewife immigration: past and present.

Joan G. Trial, Karen Alexander[2], William B. Leavenworth[2]
[1]Maine Department of Marine Resources Joan.Trial@maine.gov 207-941-4452
[2]UMass Amherst and University of New Hampshire

Alewife run timing is currently assessed at fish passage facilities on the Kennebec River in Waterville and Benton and on the Androscoggin River in Brunswick. The facilities on the Kennebec are upriver of Merrymeeting Bay; while the Brunswick facility is close to the bay. Twenty nine years of daily alewife harvest data are available for a weir operated at Abagadassett Point in the bay in the 1800's. Fish captured were assumed to be returning to the

Kennebec River. Weir harvests were recorded as early as 18 April, with 10% of annual harvests occurring between 5 and 21 May. Alewives counted at the Brunswick Dam are assumed to spawn within the Androscoggin watershed. The earliest captures at the dam from 1983 to 2010 were 5 May, with 10 % of the returns captured between 7 May and 3 June. After comparing selected quantiles of harvest at the weir and captures at the Brunswick Dam and proportional variability (PV) of the quantiles, we believe that current Androscoggin run timing is a useful surrogate for modeling temporal overlap of Kennebec River adult alewives and Atlantic salmon smolts in Merrymeeting Bay.

On-river hatchery rearing of 0+ fall parr to increase adult Atlantic salmon returns to the East Machias River, a collaborative model for salmon recovery.

Jacob van de Sande and Kyle Winslow
Downeast Salmon Federation, East Machias Aquatic Research Center, East Machias, ME
207-483-4336 jacob@mainesalmonrivers.org

For the past 20 years the focus of the stocking program in the Downeast rivers has been "unfed" fry and limited smolt stocking, but success has been limited. Research suggests that un-natural rearing conditions in hatcheries inhibit the ability of stocked fish to transition to the wild resulting in high mortality. To address the limited success of the stocking program Downeast Salmon Federation, in collaboration with federal, state, and NGO partners, is implementing a project to assess the effectiveness of "on river" hatchery reared 0+ "fall parr" to increase juvenile abundance and adult returns. The 0+parr are being reared in an "enhanced" rearing setting. Utilizing unfiltered river water, substrate incubators, dark colored tanks, natural feed, and water velocity manipulation the DSF is producing a more natural, physically fit, and more cryptic 0+ parr. All parr will be stocked in the fall after river temperatures are below 7C. Stocking densities will also be increased to well above historic levels. The project will include rigorous assessment of all life stages. Along with changes in rearing techniques, age at socking, and stocking densities, there will be a collaborative focus on addressing connectivity, adding large woody debris, and low pH mitigation in the East Machias watershed. This project is a new model for salmon recovery in the Downeast region.

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) fishery management in the St. Lawrence estuary, Québec, Canada.

Guy Verreault
Ministere des Ressources naturelles et de la Faune, Rivière-du-Loup, Qc. Canada
418~862 8213 ext. 306; Guy.verreault@mrnf.gouv.qc.ca

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) have been commercially harvested in the St. Lawrence Estuary (Quebec, Canada) for decades with mean annual landings of 50 tons. After a severe crash between 1966 and 1976, this non-regulated fishery recovered and landings peaked at record level in early nineties with signs of overexploitation. Annual monitoring was set up in mid-nineties in conjunction with severe fishing restrictions. Since then, length size distributions in annual landings moved in accordance with sturgeon sizes selected by fishermen. Fishermen preferably select sturgeon larger than 105 cm (FL) but this behavior is counterbalanced by decreasing gillnet selectivity over this threshold. Regulation enforcement and fishermen's compliance helped to stabilize annual landings below 60 tons and our analyses suggest that Atlantic sturgeon abundance is increasing and can sustain the only significant and remaining fishery in the species historical distribution range. The results from annual monitoring show that management measures are efficient and large maturing sturgeons can escape the fishery and contribute to the spawning stock.

Impact of a licences buyout program on exploitation rates and escapement of silver American eel in the St. Lawrence Estuary

Guy Verreault, Johanne Dussureault, Anne-Marie Pelletier and Patrick Gagnon
Ministère des Ressources naturelles et de la Faune, Rivière-du-Loup, Qc, G5R 3C8, Canada
418-862- 8213 ext. 306; guy.verreault@mrnf.gouv.qc.ca

Commercial fishing for silver American eel, *Anguilla rostrata*, in the St. Lawrence estuary was historically the most important fishery for this species in Canada. Facing drastic decline, a licence buyout program was implemented in 2008 and allowed the revocation of 69% of fishing licences and -48% of fishing effort. A mark-recapture experiment was set up in 2010 and 2011 to evaluate the impact on exploitation rates and escapement. Migrating silver eels were captured upstream, PIT-tagged, then released and recapture monitoring was carried out downstream in the fishery. We sampled up to 85% of total harvest and estimated the number of migrating silver eel at 155,395 (95% CI: 118 831-191 959) in 2010 and 159,700 (95% CI: 116~722-202~679) in 2011. Exploitation rate was estimated at 10.5% (95% CI 8.5% to 13.8%) in 2010 and 7.8% (95% CI 6.1% to 10.6%) in 2011. Compared with previous estimates (1996-1997), exploitation rates decreased by 53.7% and met initial objective. Although this is encouraging for decreasing anthropogenic mortalities, recent abundance estimates represent a steep decline compared to 1996-1997 estimates when annual silver eel run averaged 450,000 individuals. For restoring this species of concern throughout its historical distribution range, other additional measures than fishing restrictions are required to increase abundance and annual escapement of this fascinating fish.

Culverts, Streams and Students: A citizen science investigation of freshwater ecology

Hannah Webber[1], Beth Bisson[2], Bill Zoellick[1], Sarah Nelson[3]
[1]Education Research Manager, SERC Institute, Winter Harbor, ME 04693, (207) 288-1317, hannah@sercinstitute.org
[2]Maine Sea Grant, University of Maine, Orono, ME
[3] Senator George J. Mitchell Center for Environmental and Watershed Research, University of Maine, Orono, ME

In place-based citizen science projects, participants both contribute meaningful data to research and increase their own scientific knowledge and awareness of their communities. Maine has miles of streams with many road crossings; culverts and bridges at crossings can form barriers to movement of many wild animals, including diadromous fish. The effects of culverts, individually and cumulatively, on stream macroinvertebrate assemblages are relatively unknown. Yet, stream macroinvertebrates, primary consumers that pass energy from leaf litter

and stream algae to higher trophic levels, serve a vital role for the health of stream systems. Acadia Learning (a SERC Institute at Acadia National Park, University of Maine, and Maine Sea Grant collaboration) is piloting citizen science research engaging teachers and students in collecting macroinvertebrates above and below culverts to investigate effects of culverts on stream macroinvertebrate assemblages. Fieldwork began in September 2012. Anticipated project impacts are: (1) teachers and students will demonstrate improved understanding of habitat connectivity and stream ecology within their own community; and, (2) collaborating researchers will be able to use the project's framework of protocols and procedures to turn this pilot study into a sustained line of research. We will present preliminary analysis from the 2012 field season and share goals and objectives for the remainder of the project.

Evaluating the effects of alosine passage performance through a fish ladder on the rehabilitation of a historical fishery

Orion Weldon, Olaf Jensen, and Andrew Lahr
Institute for Marine and Coastal Studies, Rutgers University, New Brunswick, NJ;
(832)-693-4445; orion.weldon@gmail.com

Fish ladders have been considered the best solution to mitigating the effects of dams and weirs blocking diadromous fish migration. The Raritan River in New Jersey has recently removed the farthest downstream of these obstructions (Calco dam) and now relies on a fish ladder around a weir to facilitate the movement of fish upriver. However, the passage performance (attraction time (*at*), transit time (*tt*), passage time (*pt*)) of fish through these ladders depends greatly on ladder design and flow rate. Here we present the results of the first year of a two-year study using passive integrated transponders (PIT) to tag american shad (Alosa sapidissima), alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) in order to measure their passage performance through this fish ladder. During the spring 2012 migration 91 fish were injected with PIT tags in order to be detected at two antennas installed at the entrance and exit of the fish ladder. A total of five fish (<3%) were detected at one or both of these antennae showing that a very small proportion of fish are able to find the entrance of the fish ladder. Passage performance measures also varied greatly (*at* = 5 – 14d, *tt* = 15min. – 3d, *pt* = 8 – 22d) showing a high degree of heterogeneity at each stage of movement.

Preliminary Observations on the Effects of Using Clam Shells for Acid Rain Mitigation on Detritus Processing Rates in Maine Salmon Streams

Mark Whiting[1] and **Gary Williams**[2]
[1]Maine Dept. Environmental Protection, Bangor, ME 04401, 207-357-5977,
mark.c.whiting@maine.gov
[2]Tennessee Valley Authority St Albans, ME

Acid rain has depleted base cations from the soils of some of Maine's most sensitive watersheds resulting in a significant loss of buffering capacity. Project SHARE is using clam shells as a calcium carbonate supplement to mitigate stream acidity and restore brook trout and Atlantic salmon. In 2010, 2 metric tons of shells were placed in Dead Stream. In 2011, the treatment was increased to 10 tons. In 2012, the project was expanded to other tributaries of the Machias River: Bowles Brook, Honeymoon Brook, Canaan Brook, and First Lake Stream. In Dead Stream, water chemistry has improved by approximately one pH unit, and brook trout are more abundant. In May of 2012, leaf packs were placed into clam shell Treated (Dead Stream site 1) and Not Treated (Dead Stream site 2, Honeymoon Brook) sites and sampled from June – October. Acid-sensitive species such as mayflies and amphipods were most abundant at the Treated site while stoneflies, caddis flies and chironomids were abundant at all sites. Leaf processing rates were significantly different between No Treatment sites (k = 0.0060 to 0.0120; ~0.6% to 1% per day) and the Treatment site (k = 0.0202 to 0.0173; almost 2% per day). By adding buffering capacity, we created an environment that is more hospitable for microbes and leaf processors, especially scrapers and shredders, indicating that our streams appear to be impaired at an ecosystem level.

Marine-freshwater linkages via diadromous fishes

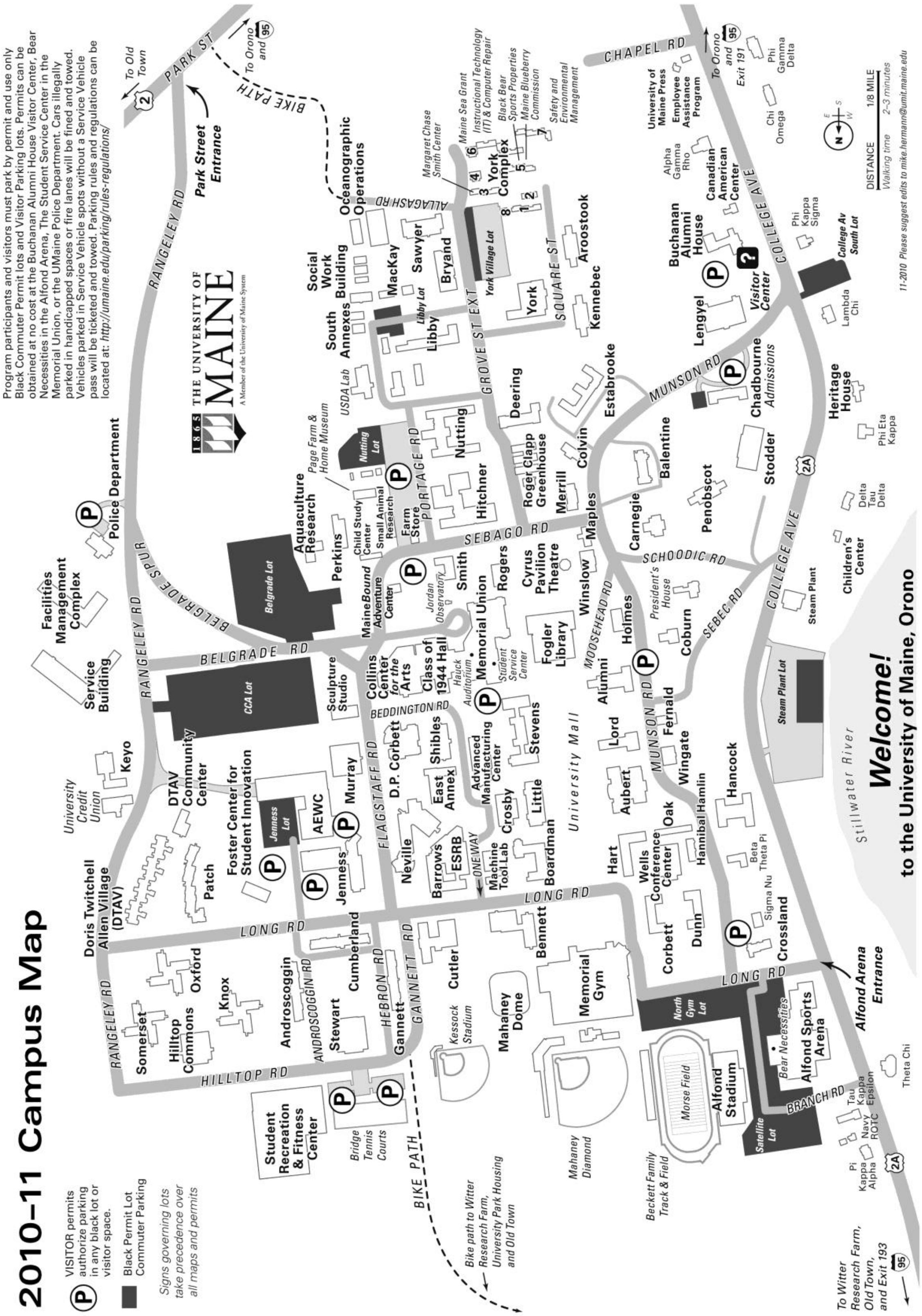
Theodore V.Willis[1], Karen A. Wilson[1], Ellen Labbe[2], Molly L.Payne[2], Miguel Barajas[1], Todd Bartlett[1], Zachary Hope[1], Jason Duff[1].
[1]University of Southern Maine, Department of Environmental Science, 207-780-5065, theowillis06@aim.com[2]Department of Biology, Gorham, ME 04038,

Our main research focus has been on marine-freshwater linkages using diadromous fishes as model organisms. Their complex life histories cross major ecological and socio-economic boundaries and require collaborative efforts to address scientific and management questions. This model system lends itself to a diversity of research questions, including habitat use, predator-prey interactions, cross-boundary ecological subsidies, and community dynamics. This poster highlights the research of several graduate and undergraduate collaborations in our lab, including: increasing our understanding of migratory behavior of alewife (*Alosa pseudoharengus*) through acoustic telemetry tracking in Penobscot Bay and River; investigating the role of river herring in the bioenergetics of smallmouth bass and Atlantic cod in the Kennebec & Androscoggin river and nearshore marine systems; modeling how diadromous fish navigate natural and anthropogenic barriers as they migrate to upstream spawning habitat using detailed survey techniques (total station and ArcGIS) and hydrodynamic models (HEC-RAS); investigating the influence of geographic distance and stocking history on the population genetics of alewives from 16 Maine rivers between the Saco and St. Croix watersheds; identifying habitat use of juvenile blueback herring (*Alosa aestivalis*) along the freshwater to marine gradient through patterns in otolith microchemistry and determining the effects of fishery exploitation on life history parameters and size at age of alewife from 16 Maine rivers.

Penobscot River American shad: who's here and who cares?

Joseph D. Zydlewski[1,2], Ann B. Grote[1], Michael M. Bailey[3], Joe Hightower[4]
[1]U.S. Geological Survey, Maine Cooperative Fisheries and Wildlife Research Unit,University of Maine, Orono, ME 04469, 207-581-2853, jzydlewski@usgs.gov
[2]Department of Wildlife Ecology, University of Maine, Orono, ME
[3] U.S. Fish and Wildlife Service, Central New England Fishery Resource Office, Nashua NH 03063
[4]U.S. Geological Survey, North Carolina Cooperative Fisheries and Wildlife Research Unit, NCSU Department of Biology, Raleigh, NC 27695-7617.

Restoration efforts in the Penobscot River include the removal of two main-stem dams (48 and 60 rkm) and improvements of passage at the lowest remaining dam, Milford (rkm 62). Shad are present in the Penobscot River, though presumed to be few, and stocking has been proposed. To assess the theoretical benefits of stocking, we built a deterministic population model. The base model was very sensitive to initial population size and stocking was effective only at low population size. This work has highlighted current population level as a critical uncertainty for restoration. Hydroacoustic (DIDSON) imaging surveys were used to monitor fish approaching the Veazie Dam fish ladder in order to inform American shad abundance in the river. The length distribution of DIDSON-imaged fish describes three peaks which correspond to river herring (20-30 cm), American shad (34-54 cm), and Atlantic salmon (48-90 cm). Comparisons of the hydroacoustic measurements with the species length distributions were used to estimate the proportion species encounters in the DIDSON footage, and to validate the timing of the shad run. A Bayesian mixture model was used to estimate species contributions to the observed targets. American shad accounted for three quarters of the observations, indicating that numbers of Penobscot River American shad may be greater than initially assumed.


2010–11 Campus Map
VISITOR permits authorize parking in any black lot or visitor space.
Black Permit Lot Commuter Parking
Signs governing lots take precedence over all maps and permits
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Program participants and visitors must park by permit and use only Black Commuter Permit lots and Visitor Parking lots. Permits can be obtained at no cost at the Buchanan Alumni House Visitor Center, Bear Necessities in the Alfond Arena, The Student Service Center in the Memorial Union, or the UMaine Police Department. Cars illegally parked in handicapped spaces or fire lanes will be fined and towed. Vehicles parked in Service Vehicle spots without a Service Vehicle pass will be ticketed and towed. Parking rules and regulations can be located at: http://umaine.edu/parking/rules-regulations/
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To Old Town
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To Orono and 95 Exit 191
To Witter Research Farm, Old Town, and Exit 193
Bike path to Witter Research Farm, University Park Housing and Old Town
BIKE PATH
PARK ST
RANGELEY RD
BELGRADE SPUR
BELGRADE RD
LONG RD
HILLTOP RD
ANDROSCOGGIN RD
HEBRON RD
GANNETT RD
FLAGSTAFF RD
BEDDINGTON RD
SEBAGO RD
PORTAGE RD
GROVE ST EXT
SQUARE ST
ALLAGASH RD
CHAPEL RD
MUNSON RD
MOOSEHEAD RD
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Hilltop Commons
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Gannett
Student Recreation & Fitness Center
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Hannibal Hamlin
Oak
Aubert
Lord
Hancock
Wingate
Fernald
Alumni
Holmes
Coburn
Steam Plant Lot
Steam Plant
Children's Center
Boardman
Little
Crosby
Machine Tool Lab
ESRB
Barrows
Neville
East Annex
Shibles
D.P. Corbett
Advanced Manufacturing Center
Stevens
Memorial Union
Student Service Center
Hauck Auditorium
Class of 1944 Hall
Collins Center for the Arts
Sculpture Studio
CCA Lot
Fogler Library
Winslow
Cyrus Pavilion Theatre
Rogers
Smith
Jordan Observatory
Maine Bound Adventure Center
Belgrade Lot
Perkins
Aquaculture Research
Child Study Center
Small Animal Research
Farm Store
Page Farm & Home Museum
Nutting Lot
Hitchner
Nutting
Roger Clapp Greenhouse
Merrill
Maples
Carnegie
President's House
Penobscot
Balentine
Colvin
Estabrooke
Deering
Stodder
Delta Tau Delta
Phi Eta Kappa
Heritage House
Chadbourne Admissions
Lengyel
Visitor Center
Buchanan Alumni House
Lambda Chi
College Av South Lot
Phi Kappa Sigma
Canadian American Center
Alpha Gamma Rho
Employee Assistance Program
University of Maine Press
Chi Omega
Phi Gamma Delta
USDA Lab
South Annexes
Social Work Building
Libby Lot
Libby
MacKay
Sawyer
Bryand
York
Kennebec
Aroostook
York Village Lot
York Complex
Oceanographic Operations
Margaret Chase Smith Center
Maine Sea Grant
Instructional Technology (IT) & Computer Repair
Black Bear Sports Properties
Maine Blueberry Commission
Safety and Environmental Management
DISTANCE 1/8 MILE
Walking time 2–3 minutes
11-2010 Please suggest edits to mike.hermann@umit.maine.edu